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THE COMMON MOLE OF THE EASTERN UNITED STATES.

By THEO. H. SCHEFFER, *Assistant Biologist.*

DISTRIBUTION.

Within the boundaries of the United States are five recognized groups of true moles. Two of these are confined to the Pacific coast, and three are distributed over the section east of the one hundredth meridian extending from Canada to the Gulf. There are no moles in the Rocky Mountain region, and their range is very restricted in the Great Basin and on the Great Plains. The common mole¹ may be found almost everywhere south of the New England States, New York, Michigan, and central Wisconsin, except in the mountain regions. In the latter districts and in the greater part of Pennsylvania, New York, and New England the common mole is replaced by the star-nosed mole² and Brewer's mole.³

The general distribution of the mole seems to depend very largely on the condition of the soil and on the humidity of the climate. Moles are absent altogether from our arid regions, and where the prairies of the West merge gradually into the plains they are found only along water courses. In these regions of deficient rainfall the ground is so dry and hard the greater part of the year as to be wholly unsuited to the existence of earthworms and the various insect larvæ upon which the mole depends for subsistence. The mole is most abundant in moist, rich soils along streams, particularly if these situations are somewhat shaded.

DESCRIPTION.

The mole is so seldom seen, even by those who are familiar with its work, that it is often confused with other small creatures, particularly the shrew, the vole or meadow mouse, and the pocket gopher.

¹ *Scalopus aquaticus.*

² *Condylura cristata.*

³ *Parascalops breweri.*

NOTE.—This bulletin treats of the mole found east of the one hundredth meridian. It contains an account of its habits, the nature of the damages committed by it, and the methods employed for its destruction. It also seeks to remove some popular misconceptions concerning this little animal. It is of interest to gardeners, lawn makers, caretakers of parks and cemeteries, etc.

It can, however, be readily distinguished from any of these by its short, stout, front limbs ending in broad, rounded hands with palms turned outward. It has a rather elongated body, close, plushlike fur, a pointed snout, and a short tail. Neither external eyes nor ears are in evidence. If not totally blind, the mole can at best merely distinguish between light and darkness, as the vestigial organs of sight lie wholly beneath the skin.

HABITS.

The mole is a creature of strictly subterranean habits. Such experiences as fall to its lot must necessarily come through its sensitive



FIG. 1.—Mole ridges in a sandy pasture.

touch, acute hearing, or highly developed powers of smell. While the animal is seldom seen above ground, it sometimes ventures out of its tunnels, perhaps chiefly at night.

RUNWAYS AND NESTS.

The living quarters of the mole consist of a series of galleries and tunnels 12 to 15 inches beneath the surface of the ground—usually deep enough to escape the plow. This central part of the system of runways can ordinarily be located by little piles of earth thrust up from deeper tunnels. These elevations are easily distinguishable from the surface ridgings (figs. 1 and 2) caused by the mole's burrowing just beneath the sod. They may be looked for on the higher spots of an open field or where natural objects offer concealment and shelter.

There are no "mole hills" in this country, such as are referred to in discussions of the European mole.

The nest of the mole is usually in a chamber 4 or 5 inches in diameter and about a foot beneath the surface. In all cases that have come under the writer's observation the materials of the nest consist mainly of closely cropped pasture grasses with the fine fibrous roots attached. It is probable that this grass stubble was pulled down by the roots into the upper surface burrows and then carried to the nesting chambers. When located near trees the nests sometimes consist of leaves mixed with grass.



FIG. 2.—Showing the mole's method of repairing runways. Lower right-hand fork not repaired.

Certain galleries or passages leading out from the deeper central system trend upward here and there to join the shallow subsurface runs that range over the mole's hunting grounds. These hunting paths produce the ridges with which we are familiar in our lawns, gardens, and fields. Beneath these ridges the little animal hurries along at irregular intervals in search of food, and when occasion demands, it extends the limits of its operations by pushing out into untouched soil. As it extends the subsurface runways its movement is almost literally one of swimming. With powerful action of the heavy shoulder muscles the hands are brought forward, palms outward, until they almost or quite touch in front of the snout. They are then thrust outward and backward to push the soil aside, while the body follows in the passageway thus created.

ACTIVE PERIODS.

It is commonly believed that the mole works only at regular periods each day, but direct observations taken in late summer and in the fall fail to show that there is any one time of day when it is more active than at others.

If a slight opening is made into a mole's runway the little animal will invariably repair the breach (fig. 2) when it next comes that way. By taking advantage of this habit one can gain much information by visiting, at short intervals through the day, each of a number of runs in which a small break has been made. In an experiment by the writer 50 runs were thus kept under observation for periods of several days at a time with results indicating that moles are as likely to be found at work one hour of the day or night as another.

As to seasonal activity, it may be said that moles are probably never dormant, that they never hibernate. They may be trapped at any time of the year when the ground is not frozen too hard to prevent the working of the trap. It must be understood, however, that extension of surface runways occurs mainly at times when soil conditions are favorable—after rains in the summer or during periods of thawing in the winter. At other times the mole may secure his food by retraversing his old runs or by working at depths unaffected by frost or drought. Movements of soil-inhabiting worms, insects, and larvæ tend to bring ever fresh supplies of food into the moles' passageways.

NATURAL ENEMIES AND CHECKS.

By reason of its secluded life the mole is little subject to attacks by the many foes of other small mammals. Its burrow is so small that no formidable enemies except weasels or snakes can follow in the passageways, and as it seldom leaves these there is little chance of its being seen by predatory animals. However, the movement of the soil when a mole is working near the surface may readily be detected by a watchful foe, and it is probable that hungry foxes and coyotes secure a tidbit now and then by springing suddenly upon a disturbed spot of earth and hurriedly digging out the furry little miner. On the other hand there is evidence that moles are distasteful to some animals, for they are seldom eaten by domestic cats and dogs which have learned to catch them. A peculiarly disagreeable odor attaching to the mole may account for its not being relished by the carnivora. It is quite likely, also, that the dense, soft fur is objectionable to some animals.

Among the birds of prey hawks and owls take small toll from the mole tribe. An examination of the stomach contents of over 2,000

of these birds disclosed the remains of but 13 moles.¹ Five of these had been eaten by the red-tailed hawk, four by the red-shouldered hawk, and one each by the broad-winged hawk, the barred owl, the great gray owl, and the screech owl. Of 3,005 skulls of small mammals found in pellets disgorged by the barn owl, only two were of the mole.

Occasional or periodical floods which spread over lowlands adjoining streams constitute one of the greatest checks on the inordinate increase of moles. During these inundations numbers of moles may be found clinging to drift masses lodged against various obstructions. Even though these individuals survive, their young have probably perished in the nests, for it is in the breeding season that the freshets commonly occur.

BREEDING HABITS.

Judging from the facts presented under the preceding heading, it would appear that the mole may be a comparatively slow breeder and still maintain its normal numbers from year to year. Such we find to be the case. From observations taken in the Middle West it was learned that the little animal breeds but once a year and that the number of young at a birth averages about four. These are produced in March or early April. Development after birth is comparatively rapid, for young found in the nest still hairless had already attained one-third the weight of the adults. Furthermore, young moles trapped in the fall are almost fully grown.

TRESPASSERS.

It is interesting to note that the mole is not permitted to enjoy undisputed occupancy of the underground galleries which his industry has constructed. Certain other small mammals, particularly shrews, voles or meadow mice, and sometimes ordinary house mice, find these tunnels convenient byways for marauding. As a result of this trespassing the reputation of the mole suffers, for most of the injury to seed grains, tubers, and roots of cultivated plants is directly chargeable to these intruding rodents. A study of tooth marks on the damaged products will bear out this statement.

NATURAL FOOD.

The food habits of moles have been the subject of much discussion, but considering the multiplied evidence of digestive tract, dentition, stomach contents, and choice of food when in captivity, it must be

¹ See "Hawks and Owls of the United States in their Relation to Agriculture," by Dr. A. K. Fisher. U. S. Dept. of Agriculture, Division of Ornithology and Mammalogy, Bull. 3, 1893.

admitted that the mole is a carnivorous animal. There is little to be gained by quibbling over the fact that a small quantity of vegetable matter is sometimes found in the mole's stomach. The economic status of an animal ought not to be prejudiced by laying undue emphasis on its trifling digressions from the normal.

From an examination of the stomach contents of 200 moles taken in all months of the year it was found that earthworms and white grubs constitute the bulk of the food. Beetles and their larvæ and other insects that enter the ground, spiders, centipedes, cocoons, and puparia also form a part of the diet. In one stomach were found the remains of 171 small white grubs, in another 250 ant puparia, in another 10 cutworms, and in another 12 earthworms. The presence of starchy material in some of the stomachs is proof that the mole occasionally finds vegetable food, as certain seed grains softened by contact with the moist soil, an acceptable addition to its worm and insect diet. Seed coats of corn, wheat, oats, and peanuts have been identified in a few stomachs.

In captivity moles ravenously eat beefsteak, flesh of birds, fish, or almost any sort of fresh meat. Owing to their activity they sometimes consume each day a bulk of food equal to their own weight. In an experiment with over 30 captive moles the writer has known but one to touch field corn or tubers when placed within easy access. A few ate green sweet corn from the cob, but numbers starved to death when supplied with white potatoes and sweet potatoes.

INJURY AND DEPREDACTIONS.

Complaints of damage or depredations by moles are frequent and insistent. In most cases, perhaps, the charges if investigated would be sustained by the evidence presented; for in situations where the mole is not wanted it is considered an intolerable nuisance. In very many cases, on the other hand, a thorough investigation would show that the small rodents which follow in the mole's runways are wholly responsible for the damage to seed grains and cultivated food products that grow underground.

In lawns, parks, cemeteries, kitchen gardens, flower beds, and like situations the mole may be regarded from our standpoint as a useful animal out of place. In pursuing its natural inclination to tunnel through the soil in search of food it injures roots of plants, displaces seeds, upridges the sod, and leaves passageways for plunderers to follow. Not only are grasses, plants, and flowers thus materially injured, but unsightly ridges are left. The presence of moles in these situations probably is evidence of a heavy infestation of the soil by white grubs, but the case in point is only another illustration of the old saying that the remedy may be worse than the disease.

HOW TO DESTROY THE MOLE.

When it is desirable to destroy moles, the trap will usually be found the most efficient means. So far all experiments undertaken with the object of finding an acceptable poisoned bait have given negative results, as the very nature of the animal's food makes it difficult to secure a satisfactory substitute for living grubs, worms, and insects. Then, too, the little animal seems shrewd and quick to sense the danger in poisoned substances.

A number of excellent mole traps are on the market, and most of them will give good results if properly set. However, the mechanism of a trap is of secondary importance to the operator's knowledge of the mole's works and ways. All makes of traps that have come under the writer's observation may be divided into three classes—the harpoon type, the scissor-jaw type, and the choker type. Harpoon-type traps (fig. 3, *a*) are designed to impale the mole in the soil by spring-driven spikes. Scissor-jaw traps (fig. 3, *b*) are intended to be set astride the runway to grasp the mole firmly when he attempts to pass from either direction. The choker type (fig. 3, *c*, and fig. 4) has a pair of wire loops that encircle the burrow when the trap is set. All three types are designed to be sprung by the same sort of mechanism—a trigger pan resting on a depressed portion of the mole ridge in such a way as to be lifted when the animal passes beneath. No part of an efficient mole trap may be in the runway itself, as any intrusion of this sort will almost invariably excite the natural suspicion of the animal to the extent of leading him to burrow around or beneath even a slight obstruction.

Only general directions for setting mole traps can be given here. Specific instructions for handling any particular make of trap should be furnished by the manufacturer. A mole trap can be successfully operated only when set on that part of a runway that is near enough to the surface to upridge the sod or soil. A little observation will soon enable one to distinguish the newer and more frequently used runways from those that have been partially or wholly abandoned. A little cracking of the soil where the sagging roof of the ridge has been raised again, a few particles of fresh earth thrust out to close a tiny opening or crevice, the wilting of grass or foliage along the course—these are indications of an occupied runway. When in doubt the question may always be settled by making a small breach in the ridge, and if that particular part of the burrow is in use the mole will invariably repair the break when he comes that way on his rounds. By following this plan all the centers of mole activity on one's premises may be definitely located. In placing the trap one of the stretches of the run that seems to be leading in some definite direction should be selected, rather than one of the turns of a labyrinth that may not be traversed every time the mole comes in the vicinity.

Before setting the trap it is well to ascertain the course of the burrow by thrusting down a lead pencil, or stick of about that size. The trap selected should then be lined up with the course as nearly as

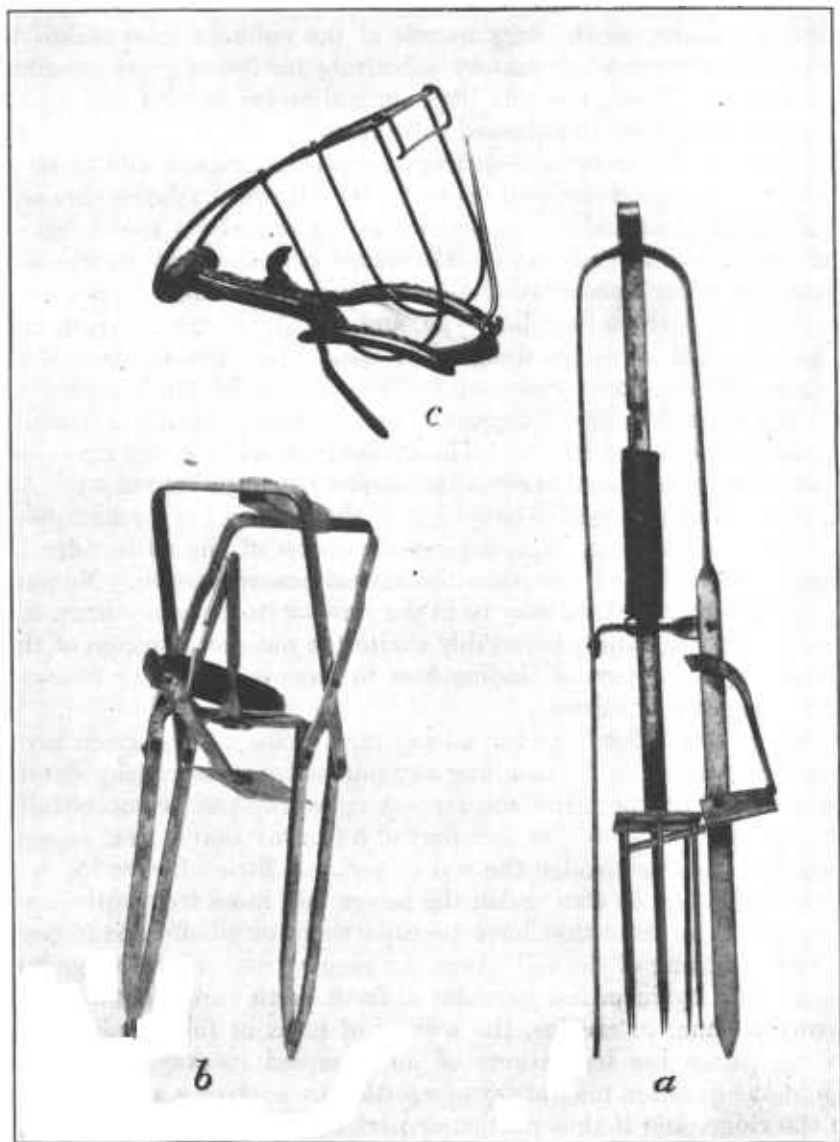


FIG. 3.—Types of mole traps: *a*, harpoon type; *b*, scissor-jaw type; *c*, choker type.

possible; the jaws of the scissor-jaw type should straddle it, the loops of the choker type should encircle it, and the spikes of the harpoon type should be directly above it. In the case of the harpoon type it is best to force the impaling spikes into the ground once or

twice to facilitate their penetrating into the burrow when the trap is later sprung. It is also desirable, in setting any of the traps, to depress only that part of the mole ridge that is immediately beneath the trigger pan, using the hand instead of the foot for this purpose. A little earth may be built up snugly under the pan if necessary. Avoid treading upon other parts of the runways. It will pay to visit the traps at least twice a day.

The persistence of the mole in repairing breaks in his runways (fig. 2) is equaled only by that of the spider in mending its torn web. One can take advantage of this known trait not only in selecting locations for trapping, but in planning the capture of the animal alive. Though requiring more time and attention than trapping, the method of catching moles by surprising them at work is fairly practicable. In following this plan one should open up 5 or 6 feet of ridge in each of the several distinct runway systems and make the rounds of subsequent inspection every few minutes. When a mole is found repairing a break he can be tossed out with a shovel and dispatched.

Repeated leveling of the mole ridges on a lawn by means of a roller, not only tends to discourage the animals from making further incursions, but prevents that injury to the grass roots which otherwise would result and restores to the lawn its more sightly appearance.

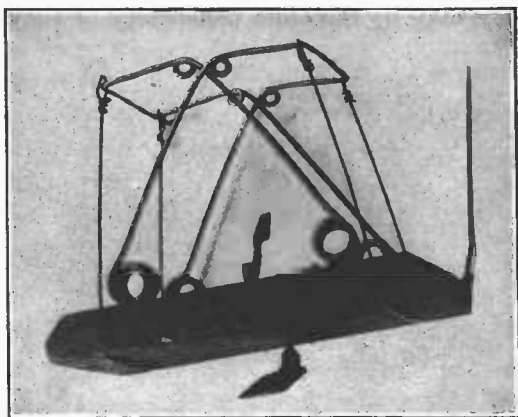


FIG. 4.—Mole trap of the choker type, devised and used by the Biological Survey.

ECONOMIC STATUS.

As to the economic status of the mole it may be said that by its activities it commends itself to farmer and gardener for reasons other than that of its food habits. One of the most abundant of small mammals, for ages it has been working over the soil to the benefit of plant life. This tunneling by the shifting of earth particles permits better aeration of the soil and favors the entrance of water from the surface. It also mixes the soil and subsoil, carrying humus farther down and bringing the subsoil nearer the surface, where its elements of plant food may be made available.

The mole has also a commercial value, as in recent years, owing to the gradually decreasing number of wild fur-bearing animals, mole-skins have found a ready market. It is significant of our lack of attention to small business matters, however, that American mole-skins are not quoted or offered on the markets. All the skins used by our furriers are imported from Europe. Auction lists of fur dealers in London show that more than 3,000,000 moleskins were sold in 1911, 1912, and 1913. Recently a small lot of American mole-skins secured by the Biological Survey was prepared and made up by an expert furrier, who pronounced them in every respect equal or even superior to European skins. It seems likely, therefore, that a new industry amounting to many thousands of dollars annually might be developed in this country. As the price of labor in the United States is higher than in Europe, it is possible that for the present the farmer boy may be the chief beneficiary of the new industry.

